# Two-Year Outcomes of Open Shoulder Anterior Capsular Reconstruction for Instability From Severe Capsular Deficiency

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**Purpose:** To document outcomes after anterior capsulolabral reconstruction for recurrent shoulder instability in 15 patients (20 shoulders) who have had multiple failed stabilizations or collagen disorders. **Methods:** Twenty shoulders with recurrent instability underwent revision stabilization with allograft reconstruction of anterior capsulolabral structures, which re-creates the labrum and capsular ligaments. The patients comprised 3 men and 12 women (mean age, 26 years [range, 18 to 38 years]) in whom multiple prior repairs failed and who had disability from continued pain and instability. Patients could choose to undergo either arthrodesis or salvage allograft reconstruction or to live with permanent disability. Of the patients, 5 had Ehlers-Danlos syndrome whereas 10 had hyperlaxity syndromes without genetic confirmation. Failure was defined as further instability surgery. Pain, shoulder function, instability (dislocations/subluxation), and American Shoulder and Elbow Surgeons scores were documented. **Results:** At follow-up, 9 of 20 shoulders (45%) remained stable. Recurrent instability was reported in 5 shoulders (25%), but the patients chose not to undergo further surgery. In the 14 shoulders without further stabilization (nonfailures), the mean American Shoulder and Elbow Surgeons score increased 43 points at a mean of 3.8 years (range, 2 to 6 years) postoperatively ($P < .05$). Mean satisfaction with outcome in nonfailures was 7 of 10 points (range, 1 to 10). Six shoulders failed by progressing to instability surgery at a mean of 8.6 months (range, 2.8 to 24 months). In the 6 shoulders that failed, the mean number of prior surgeries was 8 (range, 3 to 15) compared with a mean of 4 prior surgeries (range, 1 to 16) for the 9 nonfailures. **Conclusions:** Treating patients in whom multiple stabilizations have failed remains challenging. In our series 9 shoulders (45%) remained completely stable at 3.8 years. Recurrent instability (3 reinjuries) requiring further stabilization occurred in 6 (30%). Subsequent treatment for non-instability reasons was performed in 3 (15%). Instability was reported but revision surgery was not performed in 5 (25%). In 8 nonfailures (64%), the patients were highly satisfied with their surgical outcomes. Our results support this salvage procedure as a viable alternative to arthrodesis in young patients with end-stage shoulder instability or collagen disorders. **Level of Evidence:** Level IV, therapeutic case series.

"End-stage" shoulder instability in young patients may be attributed to complex issues of bone loss about the glenohumeral joint, capsular insufficiency, or both.[1-4] Capsular attrition and insufficiency in this patient population may be attributed to multiple failed prior surgeries, failed postoperative rehabilitation, previous thermal capsulorrhaphy resulting in tissue necrosis, or hereditary collagen disorders.[5-8] Results of revision stabilization attempts are compromised by inadequate or poor-quality capsular and labral tissue and by potentially undiagnosed connective tissue disorders or abnormalities.

Several surgical techniques, both nonanatomic[9] and anatomic,[2,8,10] have been described to address the reconstruction of the anterior glenohumeral capsule and ligaments as salvage procedures for end-stage shoulder instability and/or the treatment of instability in

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patients with collagen disorders. Successful restoration of glenohumeral stability without recurrent dislocation has been documented in 65% to 96% of patients in these series.[2,8,10] Optimal allograft/autograft choices, specific methods for graft placement and fixation, and ideal rehabilitation protocols for these reconstructions remain controversial.

The surgical technique for allograft tibialis anterior tendon reconstruction of the main stabilizing structures of the anterior labrum, the middle glenohumeral ligament, and the anterior band of the inferior glenohumeral ligament has been previously published.[1] This reconstruction technique allows for precise placement and tensioning of the allograft tendon.

The purpose of our study was to examine the midterm results of anterior capsulolabral reconstruction with a free soft-tissue tibialis anterior allograft tendon or hamstring autograft for recurrent end-stage instability as a useful salvage procedure in patients with capsular deficiency or pathologic collagen.

## METHODS

This was an institutional review board–approved (Vail Valley Medical Center Institutional Review Board No. 2005-10) retrospective review of patients surgically treated by a single surgeon at 2 locations. Data collected included age, gender, surgical findings, prior surgical information, time to subsequent surgeries, and complications. Follow-up subjective data were obtained by mailed questionnaires. Twenty shoulders in 15 patients had capsular reconstruction with a free soft-tissue graft. The surgeries were performed between 2002 and 2008. Of the shoulders, 18 were reconstructed with a tibialis anterior tendon allograft and 2 were reconstructed with an autograft hamstring tendon. Inclusion criteria were patients aged 18 years or older, documented capsular or labral attrition from previous failed surgery and failure of nonoperative care for at least 3 months, and in select cases, the request for the procedure after successful recovery from the same technique on the contralateral shoulder in patients with collagen disorders. Capsular deficiency was identified by previous arthroscopic images or by magnetic resonance imaging. Patients with bony deficiencies (either glenoid or humeral) were excluded.[11,12] After a comprehensive workup including physical examination, radiographs, and magnetic resonance imaging, all patients included in our series were considered salvage candidates. Options discussed included living with their disability, undergoing revision stabilization with some type of salvage procedure, and undergoing glenohumeral arthrodesis. No patients opted to live with their disability or to undergo fusion. Thus the 15 consecutive patients with 20 shoulders who underwent surgical treatment for recurrent end-stage instability were included in this cohort. We excluded 4 patients with 4 shoulders who were treated during this time period because they did not meet inclusion criteria and had confounding copathology (severe arthritis) and pain issues unrelated to the capsular reconstruction.

Of the 15 patients, all had prior failed surgical procedures and had disability from pain and instability. There were 3 men and 12 women. The mean age at surgery was 26 years (range, 18 to 38 years). Patients had a mean of 4.5 unsuccessful prior shoulder surgeries (range, 0 to 16). For clarification, the patient with no prior surgery presented with contralateral shoulder instability after successful revision allograft reconstruction and requested the same procedure as an index treatment. The patient was counseled about her diagnosis of hyperlaxity syndrome and elected to undergo this procedure performed primarily on her contralateral shoulder. Of the patients, 5 had type III Ehlers-Danlos syndrome (EDS) whereas 10 had hyperlaxity syndromes without genetic confirmation, as evidenced by physical examination findings of generalized ligamentous laxity. One had capsular necrosis due to prior thermal capsulorrhaphy and multiple surgeries.

### Surgical Technique

The surgical technique for anterior capsulolabral reconstruction with a free soft-tissue graft has been previously described.[1] In brief, with the patient in the beach-chair position and by use of a pneumatic arm holder, the glenohumeral joint was approached through a standard deltopectoral incision. In many cases extensive scarring will be present that changes the soft-tissue planes. Therefore we prefer to perform an open tenodesis of the intra-articular portion of the long head of the biceps and excise any excess scarring tissue. The subscapularis tendon and the anterior capsule, which was invariably scarred to the subscapularis tendon, was taken down in a single layer from the lesser tuberosity and tagged with sutures. Once good exposure of the glenoid was obtained, the glenoid neck was prepared with a bur. Any residual anterior labrum was removed. We used 3 or, preferably, 4 suture anchors (bioabsorbable 3.0-mm Bio-SutureTak; Arthrex, Naples, FL) as points of fixation for the labral reconstruction at the anterior glenoid rim. These were placed at

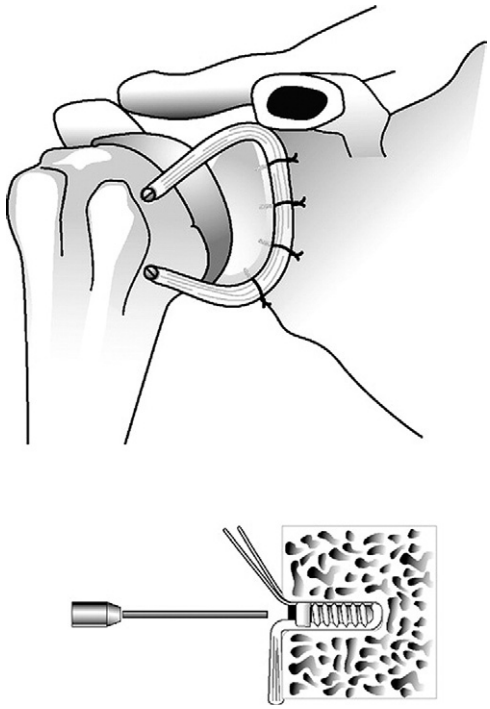

**Figure 1.** Fixation of graft limbs to humerus in bone tunnels with biodegradable interference screws. Top, Positioning of the graft was performed superomedial to the lesser tuberosity and inferiorly at the level of the inferior border of the subscapularis tendon. Bottom, The tendon was pushed in the bone tunnel and fixed by a biodegradable interference screw. (Reprinted with permission.[1])

the 2-o'clock, 3-o'clock, 4-o'clock, and 5:30 clock positions (Fig 1). A 6- or 7-mm tibialis anterior allograft or a semitendinosus autograft, which had been whip-stitched at either end with FiberWire (Arthrex), was placed along the anterior glenoid rim to reconstruct the labrum. It was then secured with the anchors starting at the middle and working superiorly and inferiorly toward the remaining anchors, allowing the surgeon to incorporate the remaining native capsule and labrum into the reconstruction. The 2 free ends of the graft were then used to reconstruct the middle glenohumeral ligament and the anterior band of the inferior glenohumeral ligament. They were fixed to the humerus in 2 appropriately sized tunnels that ran from medial to lateral and exited lateral to the bicipital groove. If a hemiarthroplasty is present, care should be taken to avoid the implant when affixing the graft. The grafts were fixed with biointerference screws (7- or 8-mm Biotenodesis; Arthrex) at the lateral tunnel aperture, away from the articular margin (Fig 2). We obtained additional fixation security, when possible, by tying the free ends of the graft tissue to each other, oversewing the construct with FiberWire suture. Tensioning of the graft was performed with the shoulder in 30° of external rotation, 30° of abduction, and 30° of forward flexion. Finally, the subscapularis tendon and adherent native capsular tissue were meticulously repaired at the lesser tuberosity. The rotator interval was imbricated in an inferior-to-superior shift, supraspinatus-to-subscapularis, or pants-over-vest fashion for additional restraint against inferior glenohumeral translation.

### Postoperative Protocol

Patients underwent strict immobilization with an abduction sling for 6 weeks postoperatively and were started on a progressive rehabilitation program beginning at 6 weeks. Hand, wrist, and elbow ranges of motion were permitted for the first 6 weeks. Pendulum exercises were initiated at 6 weeks. No external rotation past neutral was allowed until 8 weeks. Active range of motion was started at 8 to 10 weeks.

Patients were counseled that there was the potential for some loss of external rotation and forward flexion; however, the goal was to obtain a stable shoulder with at least 45° of external rotation and 140° of forward flexion.

Two-year minimum subjective follow-up was obtained, with a mean follow-up of 3.2 years (range, 2 to 6 years), in 100% of the patients. The patients' pain

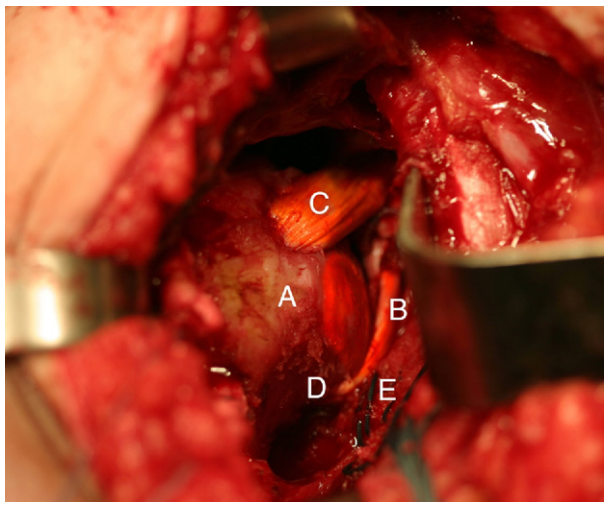


**Figure 2.** Intraoperative view with tendon graft fixed. (A) Head of humerus. (B) Tendon graft fixed to anterior glenoid rim reconstructing anterior labrum. (C) Tendon graft fixed to humerus superiorly with interference screw. (D) Tendon graft fixed to humerus inferiorly with interference screw. (E) Subscapularis tendon, secured with traction sutures, ready for repair. (Reprinted with permission.[1])

and functional outcomes were measured with the American Shoulder and Elbow Surgeons (ASES) score on a scale from 0 to 100.[13] In addition, patients rated their pain on a scale from 0 to 10, with 0 being no pain and 10 indicating extreme pain. Surgical failures were defined as cases requiring further surgery for recurrent instability/dislocation. Pain, shoulder function, symptoms of subluxation, further injuries and/or dislocations, and the ASES score were documented. Patients were also asked to rate how satisfied they were with the outcome of their surgery. This rating was based on a scale from 1 to 10, with 1 being very unsatisfied and 10 being very satisfied. Patients were asked to report any recurrent shoulder dislocation or subluxation events. Patients reported feelings of subluxation as either never, rarely, occasionally, or frequently. Patients were also questioned about the chronicity and cause of any instability reinjury to their shoulder during the postoperative period.

### Statistical Analysis

The ASES scores were normally distributed, so change in preoperative and postoperative status was compared by use of paired $t$ tests. Parametric and nonparametric statistical analysis was performed by use of the SPSS software package (version 11.0; SPSS, Chicago, IL). All reported $P$ values are 2 tailed, with an $\alpha$ level of .05 indicating statistical significance.

## RESULTS

Of the 20 shoulders treated surgically, 14 (70%) remained stable postoperatively. In contrast, 6 of the shoulder surgeries failed, and these shoulders progressed to further surgical treatment for instability after their capsular reconstruction (3 underwent revision stabilization with tibialis anterior tendon allografts, 1 underwent glenohumeral fusion, and 2 underwent Latarjet procedures) at a mean of 11.2 months (range, 3 to 24 months). Individual patient data are shown in Table 1. Overall, 5 patients (6 shoulders) reported symptoms of recurrent instability. Specifically, 3 patients reported stable shoulders until traumatic reinjuries resulted in recurrent shoulder dislocations. Two patients reported atraumatic recurrence of instability, describing subluxation events but no dislocations. Of 14 stable shoulders, 3 progressed to subsequent surgery for pain, not instability (2 coracoplasties and 1 treated for snapping scapula syndrome) at a mean of 4.9 months (range, 3.7 to 6.8 months).

Outcome results for patients who did not progress to another instability surgery are listed in Table 2. The mean preoperative ASES score was 43 (range, 27 to 67). At a mean follow-up of 3.8 years (range, 2 to 6 years) postoperatively for those patients who did not have subsequent instability surgery, the mean ASES score increased to 84 (range, 58 to 97). Mean satisfaction with surgical outcomes at follow-up was 7 of 10 points (range, 1 to 10). In 8 (64%) of the 14 nonfailures, the patients were highly satisfied with their surgical outcomes. Patients who had continued instability/dislocations had significantly lower ASES scores, with a mean of 67 (range, 58 to 75), and lower scores for satisfaction with surgical outcome, with a mean of 4 (range, 1 to 6), than the patients who reported stable shoulders, whose mean ASES score was 95 (range, 85 to 97), with a mean satisfaction score of 9 (range, 3 to 10) ($P < .05$). Type III EDS patients had a significantly lower postoperative ASES score of 71 (range, 58 to 92) versus 92 (range, 78 to 97) in patients with hyperlaxity syndromes without genetic confirmation, but their preoperative scores were similar ($P < .05$).

## DISCUSSION

Recurrent shoulder instability after open or arthroscopic treatment is most frequently attributed to poor surgical technique or unrecognized bone or soft-tissue deficiencies. Studies have shown dramatically increased failure rates of up to 44% in the setting of multiple revision stabilizations.[14] Anatomic and nonanatomic glenoid augmentation procedures have been successfully applied to cases involving glenoid insufficiency. Capsular tearing with progression to capsular insufficiency has long been understood as a major factor in recurrent instability.[3] Further studies have found capsular insufficiency most frequently linked to iatrogenic causes, specifically thermal necrosis.[6,15-18] Other investigators have shown that the quality of collagen fibrils in the shoulder capsule may differ significantly among patients and instability patterns and may contribute to the relative success of operative stabilizations.[3] Many individuals simply have hyperlaxity because of collagen disorders such as type III EDS.

The treatment of recurrent shoulder instability in the setting of anterior soft-tissue deficiency in young and active patients continues to be challenging. For such patients with both pain and instability in whom standard open and arthroscopic attempts to correct their pathology have failed, few palatable options remain.

**TABLE 1.** *Individual Patient Data*

| Patient | Age at Index Surgery (yr) | No. of Prior Surgical Procedures | Surgical History | Comorbidities | Diagnosis | Index Procedure | Reinjury | Time to Further Surgery | Type of Surgical Intervention |
|---|---|---|---|---|---|---|---|---|---|
| F 1, left | 28 | 2 | Thermal capsulorrhaphy Hemiarthroplasty | | Periprosthetic instability with recurrent anterior subluxation | Tib allograft reconstruction and rotator interval closure | No | | |
| F 2, right | 37 | 1 | Inferior capsular shift | | Chronic MDI | Tib allograft reconstruction | No | | |
| M 1, right | 37 | 2 | Revised open Bankart Magnuson-Stack | Cancer | Recurrent anterior-posterior instability | Tib allograft reconstruction | No | | |
| F 3, right | 20 | 2 | Revised open capsular shift | Type III EDS | Recurrent anterior instability and capsular insufficiency | Tib allograft reconstruction | No | | |
| M 2, left | 22 | 2 | Revised subscapularis tear | | Chronic MDI and subscapularis tear | Tib allograft reconstruction | No | | |
| F 10, left | 20 | 16 | Revised treatments for infection and Tib graft compromised | Type III EDS | Chronic MDI Hypermobility | Tib allograft reconstruction | No | | |
| F 4, left | 22 | 3 | Revised open capsular shift and arthroscopic plication | | Chronic MDI Hypermobility | Tib allograft reconstruction | No | 6.8 mo | Coracoid plasty |
| F 5, left | 36 | 3 | Open Bankart Modified Bristow Hardware removal | | Global joint laxity | Tib allograft reconstruction | No | 3.7 mo | Coracoid plasty |
| F 6, left | 19 | 2 | Arthroscopic debridement Arthroscopic pan labral plication | Asthma Keloids | Hyperlaxity with inferior instability | Tib allograft reconstruction | No | 26 mo | Snapping scapula resection |
| F 7, left | 38 | 1 | Bristow | Type III EDS | Scapula winging | Double-hamstring tendon for reconstruction | No. Return of instability | | |

**TABLE 1.** *(Continued)*

| Patient | Age at Index Surgery (yr) | No. of Prior Surgical Procedures | Surgical History | Comorbidities | Diagnosis | Index Procedure | Reinjury | Time to Further Surgery | Type of Surgical Intervention |
|---|---|---|---|---|---|---|---|---|---|
| F 8, right | 20 | 3 | Inferior capsular shift. Posterior capsular shift. Thermal capsulorrhaphy | Type III EDS | MDI, capsular deficiency, and RCT | Tib allograft reconstruction | No. Return of instability | | |
| M 3, left | 22 | 3 | Capsular reconstruction | | MDI | Double-hamstring tendon for reconstruction | Yes. Return of instability | | |
| F 9, right | 23 | 4 | Treatments for instability | Type III EDS | Chronic MDI | Tib allograft reconstruction | No. Return of instability | | |
| F 9, left | 23 | 0 | Revised treatments for instability | Type III EDS | Chronic MDI | Tib allograft reconstruction | No. Return of instability | | |
| F 7, right | 33 | 4 | Revised treatments for instability | Type III EDS | Chronic MDI | Tib allograft reconstruction | Yes. Return of instability | 12 mo | Glenohumeral fusion |
| F 10, right | 21 | 10 | Revised treatments for instability | Type III EDS | Chronic MDI | Tib allograft reconstruction | Yes. Slipped in shower | 4.3 mo | Tib allograft avulsed |
| F 10, right | 22 | 11 | Revised treatments for instability | Type III EDS | Chronic MDI | Revised Tib allograft reconstruction | No. Return of instability | 4.5 mo | Iliac crest bone graft |
| F 10, left | 20 | 15 | Revised treatments for instability | Type III EDS | Chronic MDI Hypermobility | Tib allograft reconstruction | No. Infection | 3.9 mo | Revised with Tib allograft reconstruction for infection |
| F 11, right | 18 | 3 | Arthroscopic and open shift Pectoralis major transfer with semitendinosus allograft for scapular winging | | Chronic hyperlaxity | Tib allograft reconstruction | Yes | 24.1 mo | Revised with Tib allograft reconstruction |
| F 12, left | 22 | 4 | Revised capsular reconstruction | | Chronic MDI | Tib allograft reconstruction | Yes. MVA | 2.8 mo | Latarjet |
| 20 shoulder surgeries (11 left and 9 right) | Mean, 26 (range, 18-38) | Mean, 4.6 (range, 0-16) | | 10 shoulders treated in 5 patients with type III EDS | | 18 Tib allograft and 2 double-hamstring reconstructions | 14/20 shoulders did not progress to another surgery for instability | Patients revised for instability at a mean of 11.2 mo; patients revised for pain at a mean of 4.9 mo | 6 shoulders in 4 patients failed and were revised for instability 3 shoulder surgically treated for pain reasons |

Abbreviations: EDS, Ehlers-Danlos syndrome; F, female; M, male; MDI, multidirectional instability; MVA, motor vehicle accident; RCT, rotator cuff tear; Tib, tibialis anterior tendon.

**Table 2.** *Outcome Data in Patients Who Did Not Have Further Surgery for Instability*

| Patient | Preoperative ASES Score | Follow-up (mo) | Reinjury Activity Resulting in Instability | Postoperative ASES Score | Occasional to Frequent Feeling of Shoulder Subluxation | Satisfaction With Surgical Outcomes (Scale From 1-10) |
|---|---|---|---|---|---|---|
| M 1 | 35 | 28 | | 85 | No | 9 |
| M 2 | 42 | 37.5 | | 85 | No | 10 |
| M 3 | | 73.6 | Traumatic/baseball | | Yes | 4 |
| F 1 | 65 | 41.4 | | | No | 10 |
| F 9, right | | 24 | | 67 | Yes | 6 |
| F 9, left | | 30.5 | | 67 | Yes | 6 |
| F 3 | | 24 | | 98 | No | 10 |
| F 2 | | 42.6 | | 80 | No | 3 |
| F 8 | | 53 | | 58 | Yes | 3 |
| F 7, left | | 48 | Lifting | | Yes | 1 |
| F 4 | | 43 | | 97 | No | 9 |
| F 5 | 30 | 25 | | 97 | No | 9 |
| F 6 | 63 | 26.5 | | 95 | No | 9 |
| F 10, left | 40 | 45.5 | | 97 | No | 10 |

Abbreviations: F, female; M, male.

Glenohumeral arthrodesis is 1 option to treat such end-stage instability, but most young patients remain unwilling to accept the associated sacrifice of shoulder motion. Furthermore, Richards et al.[19] in their series of glenohumeral arthrodeses described the unexpected complication of continued sensations of instability despite radiographic evidence of a solid fusion. Subsequently, there has been a continued interest in alternative salvage procedures that preserve glenohumeral motion and stabilize the shoulder by soft-tissue reconstruction techniques. In the senior author's (P.J.M.) practice over the last decade, not a single patient has elected to undergo glenohumeral arthrodesis.

Krishnan et al.[5] described their experience in treating patients (with a minimum of 3 prior attempts at shoulder stabilization) with their "kitchen sink" technique. This technique involves a classic humeral-based inferior capsular shift, a tenodesis of the biceps tendon to hold and sling the humeral head superiorly, a superior suspensory sling restoration through the coracohumeral ligament, and a rotator interval augmentation and/or reconstruction. Their technique relied on a sufficient anterior capsule to complete the shift. Their cohort excluded patients with EDS. Although they reported no recurrent dislocations or instability symptoms in 9 of 10 patients, 50% of patients in their series went on to undergo glenohumeral arthrodesis for pain and limited motion of 45° of active forward elevation. By their own admission, "soft-tissue fusion" of the shoulder may resolve instability symptoms with unpredictable resolution of pain.

The first reported cases of anterior capsular reconstruction are attributed to Gallie and Le Mesurier,[9] who eloquently described the natural history of recurrent anterior shoulder instability and their rationale for using fascia lata graft to augment the capsule in a nonanatomic fashion. They reported only 7 failures in their series of 175, including 80 armed forces personnel. Subsequently, Lazarus and Harryman[20] showed 70% success in resolving recurrent instability using semitendinosus autograft in a series of 25 patients.

Warner et al.[8] reported 3 successful cases of autograft hamstring capsular reconstruction. Moeckel et al.[21] described the successful application of Achilles allograft augmentation in the setting of unstable shoulder replacements. Iannotti et al.[2] reported a series of 7 patients (mean age, 36 years), all without subsequent shoulder subluxation or dislocation, after revision treatment with autograft or allograft iliotibial band placed in a Z pattern to re-create the anterior capsule and middle glenohumeral and anterior inferior glenohumeral ligaments. In this series, graft tensioning was determined by specific deficiencies of the anterior capsular ligaments. The deficient rotator interval reconstruction was tensioned in 0° of abduction/external rotation, the middle glenohumeral ligament in 20° of abduction/external rotation, and the anterior inferior glenohumeral reconstruction in 40° of abduction/external rotation.[2] Iannotti et al. reported that the ASES scores improved from a mean of 30 preoperatively to 55 postoperatively. There were no failures in their series at a mean follow-up of almost 4 years. Alcid et al.[10] recently reported a series of 15 patients (mean age, 30.9 years) with no recurrent dislocations

at minimum 2-year follow-up after hamstring autograft and tibialis anterior allograft anterior capsular reconstruction. Their technique involves placing 4 limbs of graft material across the anterior shoulder joint. Just over half of their patients had capsular deficiency from previous thermal capsular shrinkage, and a mean of 2.1 prior surgeries had been performed previously. The study showed no difference in satisfaction or postoperative ASES scores between patients receiving allograft and those receiving autograft. The authors reported 2 failures attributed to pain from accelerated glenohumeral arthritis that were successfully revised by total shoulder arthroplasty. Although no patients reported recurrent dislocation, one-third had symptomatic recurrent subluxations but remained satisfied with their surgery.

Our anterior capsulolabral reconstruction surgical technique, though similar to that of Iannotti et al.[2] and Alcid et al.,[10] allows for a more anatomic restoration of attenuated or absent anterior labrum and better tensioning of the graft. Given the observed complete attritional loss of viable capsule and capsular ligaments observed in our series, we tensioned our reconstruction with the shoulder in 30° of elevation and external rotation. Our results are comparable to those previously published and highlight the persistent difficulties in regaining and maintaining glenohumeral instability in young patients with end-stage instability. This was a highly challenging group of patients, most of whom had failed prior surgeries and many of whom had collagen disorders. Interestingly, both of the autograft reconstructions failed, although one of the failures was traumatic. It is likely that patients with hyperlaxity or known collagen disorders may be better treated with allograft reconstructions because of generalized tissue laxity.

Of our 6 surgical failures, 3 were attributed to traumatic reinjuries. In one instance a young male patient who had previously reported ASES scores in the high 90s and no sensation of even subtle instability for more than 3 years dislocated his reconstructed shoulder while sliding headfirst into first base while playing competitive baseball. The desired activity level of young, athletic patients should be considered when counseling such patients about the viability of this technique. In patients who plan to continue to pursue high-level activity, bone augmentation procedures, such as the Latarjet procedure, may prove to be more durable; however, no study has examined this comparison. We also performed revisions in 2 patients for subcoracoid impingement. The increased volume of anterior tissue after our reconstruction may predispose patients to this problem. We are currently investigating reliable methods to determine which patients are at risk for subcoracoid impingement in this setting and others.

This study is a retrospective review, and although our 15 patients (20 shoulders) represent one of the largest series yet reported for this very challenging problem, it is difficult to perform subgroup analyses because of the small sample size. Furthermore, we acknowledge that our findings would be better supported by physical examination and radiographic follow-up, as well as additional validated specific outcome instruments targeting instability. It is important to recognize that none of the patients in this series had clinically relevant bone defects, and many were “collagenopaths.” Previous work has shown high rates of failure when soft-tissue procedures have been used in patients considered to be “collagenopaths.” Nevertheless, we believe that many patients with end-stage shoulder instability have some degree of collagen disorder, which strongly influences the outcomes of this technique and others that rely on soft-tissue augmentation or reconstruction to address recurrent instability. Our criterion for failure was further instability surgery, but we also included data on symptomatic subluxations and subjective reports of instability/dislocations to help the reader understand the difficult nature of defining successful surgical outcomes. Conceivably, future investigations may allow for a randomized trial comparing this technique with a bone augmentation technique such as the Latarjet procedure in patients with end-stage shoulder instability.

## CONCLUSIONS

Treating patients in whom multiple stabilizations have failed remains challenging. In our series 9 shoulders (45%) remained completely stable at 3.8 years. Recurrent instability (3 reinjuries) requiring further stabilization occurred in 6 (30%). Subsequent treatment for non-instability reasons was performed in 3 (15%). Instability was reported but revision surgery was not performed in 5 (25%). In 8 nonfailures (64%), the patients were highly satisfied with their surgical outcomes. Our results support this salvage procedure as a viable alternative to arthrodesis in young patients with end-stage shoulder instability or collagen disorders.

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